

REMARKS

INTRODUCTION:

In accordance with the foregoing, claims 1, 3, 7 and 12 have been amended, and claims 16-17 have been added. No new matter is being presented, and approval and entry are respectfully requested.

Claims 1-17 are pending and under consideration. Reconsideration is respectfully requested.

OBJECTION TO THE TITLE:

In the Office Action, at page 2, numbered paragraph 2, the title was objected to as not being descriptive. In view of the proposed amended title set forth above, the outstanding objection to the title should be resolved.

CHANGES TO THE SPECIFICATION:

The specification has been reviewed in response to this Office Action. Changes have been made to the specification only to place it in preferred and better U.S. form for issuance and to resolve the Examiner's objections raised in the Office Action. That is, on page 11, lines 6, 24 and 26, "21" has been changed to --21c--, and on page 20, line 7, "ditch 21" has been changed to --ditch 22--. No new matter has been added.

OBJECTIONS TO THE CLAIMS

Claims 1, 3, 7 and 8 were objected to because of informalities with respect to antecedent basis.

Claims 1, 3 and 7 have been amended to show correct antecedent basis. Since claim 8 depends from amended claim 7, claim 8 is also believed to show correct antecedent basis.

REJECTION UNDER 35 U.S.C. §103:

In the Office Action, at pages 2-22, numbered paragraphs 4-15, claims 1-15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Isokawa (JP 05-145813 A; hereafter, Isokawa) in view of Naka et al. The reasons for the rejection are set forth in the Office Action and therefore not repeated. The rejection is traversed and reconsideration is requested.

With respect to claims 1 and 12:

The solid image-pickup device according to claim 1 of the present invention comprises an array of resin lenses arranged in a matrix on an undercoat layer. In the device, ditches are formed in portions of the undercoat layer which are located between the resin lenses, and a transparent layer is formed to cover the resin lenses and the undercoat layer. The resin lenses and the transparent resin layer form a macro lens (including portions of the transparent resin layer which are provided in the ditches).

Claim 12 of the present invention recites a method of manufacturing the solid image-pickup device according to claim 1.

In item 6 of the Office Action, the Examiner points out that the aim of Isokawa is to reduce the thickness of the transparent membrane (4) in the gaps (6) between adjacent lenses (3), and to alleviate the problem of a "thickening thickness" of the transparent membrane (4) in the gaps, and ditches are etched as shown in Figure 3 (See Office Action, e.g., page 3, line 11 to page 4, line 4).

However, paragraph 13 of Isokawa discloses that "the thickness TOX2 of the oxide film 5 is great, and the curvature of a final micro lens becomes larger than the substrate micro lens 3. Therefore, in consideration of change of a curvature by the oxide film 5 formed of SOG, it is necessary to make the curvature of the substrate micro lens 3 beforehand smaller than final-design curvature by thickening the thickness at the time of spreading of the substrate micro lens 3, etc."

Furthermore, FIG. 3 of Isokawa discloses that dry etching is performed on the substrate micro lens and the flat layer. That is, FIG. 3 is a view for use in explaining that the substrate micro lens and the flat layer are etched to form a micro lens in which no gap is provided between lenses (see paragraphs 13 and 14). In FIG. 3, a broken line appears to indicate a transparent layer covering the substrate micro lens and the flat layer, at first glance; however,

actually, it merely indicates the states of the substrate micro lens and the flat layer which are not yet subjected to dry etching.

As is clear from the above, Isokawa does not disclose or even suggest that to alleviate the problem of a "thickening thickness" of the transparent membrane (4) in the gaps, ditches are etched as shown in FIG. 3. Thus, in this regard, it is respectfully submitted that the Examiner's statement is erroneous.

Therefore, the feature of the present invention which is stated in item 3, (1) cannot be achieved by Isokawa and/or Naka et al., alone or in combination.

With respect to the differences in structure between the present invention and the references:

In Isokawa, as shown in FIGs. 1 and 3, a lens is formed of the substrate micro lens 3 and the flat layer 2 (the flat layer 2 is etched to be curved continuously with the substrate micro lens 3 by dry etching).

In contrast, the micro lens included in the solid image-pickup device according to claim 1 comprises the resin lens 21c and the transparent resin layer 21 (including portions provided in the ditches) as shown in, e.g., FIG. 2 (that is, unlike the flat layer 2 of Isokawa, the undercoat layer 17 of the present invention does not have a curvature, nor does it constitute part of the lens).

Due to the above feature which is not disclosed in Isokawa, the invention according to claim 1 or 12 provides a novel advantage which is not disclosed in Isokawa or Naka et al.

Claim 1 of the present invention recites: "a transparent resin layer covering said plural resin lenses with substantially the same thickness and the ditch between said adjacent resin lenses," which is not taught or suggested by Isokawa or Naka et al., alone or in combination.

The solid image-pickup device according to claim 1 or the micro lens of the solid image-pickup device manufactured by the method according to claim 12 comprises the resin lens 21c and the transparent resin layer 31 (including portions provided in ditches 22). Thus, the surface area of the micro lens can be increased, and the gaps between the micro lenses can be decreased, while increasing the lens efficiency.

Claim 12 of the present invention recites: "forming a photosensitive resin layer on an undercoat layer; exposing said photosensitive resin layer to light in a predetermined pattern, followed by a developing treatment so as to form a resin pattern layer having a predetermined gap width; subjecting said resin pattern layer to a heat flow so as to form a resin lens array which is 2-dimensionally arranged a plurality of resin lenses; applying an etching treatment to those portions of said undercoat layer which are exposed in regions between adjacent resin lenses to form ditches; and forming a transparent resin layer on the surfaces of said resin lenses and said undercoat layer," which is not taught or suggested by Isokawa or Naka et al., alone or in combination.

With respect to claim 7:

The Examiner rejects claim 7 under 35 U.S.C. §103(a) as being unpatentable over Isokawa in view of Naka et al.

The Applicants respectfully disagree with this rejection, and submit the following arguments:

With respect to claim 7, the Examiner points out that, according to the Pythagorean theorem, the diagonal distance across the lens array is naturally greater than each of the two arranging directions (X/Y or horizontal/vertical) of the lens array, and the transparent layer in the gaps in the arranging directions evidently becomes thicker than on top of the lenses, and the transparent layer in the gaps in the diagonal direction evidently becomes thinner than on top of the lenses (see item E of the Office Action).

However, claim 7 recites that "the difference between the height of the surface of said transparent layer in the ditch in the diagonal direction of said lens array and the height of the tops of the micro lenses" is larger than "the difference between the height of the surface of said transparent layer in the ditch in the arranging direction of said lens array and the height of the top of the micro lens."

Thus, Applicants respectfully submit that the Examiner's above point is erroneous.

Please note that, in general, a transparent resin layer tends to be thinner and smoother in the XY direction (the diagonal direction of the lens array) as disclosed in the present specification, page 14, lines 9-26. On the other hand, claim 7 recites that "the difference between the height of the surface of said transparent layer in the ditch in the diagonal direction

of said lens array and the height of the tops of the micro lenses each consisting of said resin lens and said transparent resin layer covering the surface of said resin lens is the difference between the height of the surface of said transparent layer in the ditch in the arranging direction of said lens array and the height of the top of the micro lens." This is opposite to the above tendency of a transparent resin layer. That is, a solid image-pickup device according to claim 7 is formed to have a transparent layer which is formed in a manner opposite to the general tendency of a transparent resin layer.

Claim 7 of the present invention recites: "a transparent resin layer covering said plural resin lenses and said ditch, wherein a micro lens array is formed which comprises a plurality of micro lenses arranged in a matrix, the micro lenses including the resin lenses and parts of the transparent resin layer which cover the resin lenses, respectively, wherein the difference between the height of the surface of said transparent layer in the ditch in the diagonal direction of said lens array and the height of the tops of micro lenses each consisting of said resin lens and said transparent resin layer covering the surface of said resin lens is larger than the difference between the height of the surface of said transparent layer in the ditch in an arranging direction of said lens array and the height of the top of the micro lens," which is not taught or suggested by Isokawa or Naka et al., alone or in combination.

Thus, the solid image-pickup device according to claim 7 obtains a novel advantage, as is disclosed in the specification, e.g., page 14, line 26 to page 15, line 24, by the use of the structural feature, which is not disclosed in Isokawa or Naka et al.

Thus, as admitted by the Examiner, Isokawa does not disclose that a transparent layer is a transparent resin layer. In addition, Naka et al. only discloses covering microlenses with a transparent resin layer that serves as a flattening layer (col. 4, lines 14-19) over the plurality of microlenses, that may be photo-etched in a square or stripe pattern to leave the photosensitive resin in a sectionally rectangular shape on the substrate (see col. 2, lines 50-61 and claim 13) or may be used to provide a molded package for the device (col. 8, lines 5-19). Hence, it is respectfully submitted that neither Isokawa nor Naka et al. teaches or suggests a transparent resin layer covering plural resin lenses with substantially the same thickness (as per independent claim 1 of the present invention), a transparent resin layer having the height differences that are cited above (per independent claim 7 of the present invention) or a transparent resin layer on the surfaces of the resin lenses with ditches between adjacent resin lenses (per independent claim 12 of the present invention).

Thus, it is respectfully submitted that independent claims 1, 7 and 12 are non-obvious in view of Isokawa and/or Naka et al., alone or in combination, and are allowable under 35 U.S.C. §103(a). Since claims 2-6, 8-11 and 13-15 depend from independent claims 1, 7 and 12, respectively, claims 2-6, 8-11, and 13-15 are submitted to be non-obvious in view of Isokawa and/or Naka et al., alone or in combination and to be allowable under 35 U.S.C. §103(a) for at least the reasons that independent claims 1, 7 and 12 are submitted to be non-obvious in view of Isokawa and/or Naka et al., alone or in combination, and to be allowable under 35 U.S.C. §103(a).

NEW CLAIMS

New claim 16 recites that the features of the present invention include the method of manufacturing a solid image-pickup device according to claim 12, wherein said transparent resin layer is formed to cover the surfaces of said resin lenses such that portions of said transparent resin layer which cover the surfaces of said resin lenses have substantially a same thickness and also cover a surface of said undercoat layer which includes the ditches.

Nothing in the prior art teaches or suggests such. It is submitted that new claim 16 distinguishes over the prior art.

New claim 17 recites that the features of the present invention include a solid image-pickup device, comprising: a micro lens array formed by a plurality of resin micro lenses arranged in a matrix; an undercoat layer to fix said micro lens array and having a ditch formed between adjacent said resin micro lenses; and a transparent resin layer covering said plural resin micro lenses with substantially the same thickness and the ditch between said adjacent resin micro lenses.

Nothing in the prior art teaches or suggests such. It is submitted that new claim 17 distinguishes over the prior art.

CONCLUSION:

In accordance with the foregoing, it is respectfully submitted that all outstanding objections and rejections have been overcome and/or rendered moot, and further, that all pending claims patentably distinguish over the prior art. Thus, there being no further

outstanding objections or rejections, the application is submitted as being in condition for allowance which action is earnestly solicited.

If the Examiner has any remaining issues to be addressed, it is believed that prosecution can be expedited by the Examiner contacting the undersigned attorney for a telephone interview to discuss resolution of such issues.

If there are any underpayments or overpayments of fees associated with the filing of this Amendment, please charge and/or credit the same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

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By: Darleen J. Stockley
Darleen J. Stockley
Registration No. 34,257

1201 New York Avenue, N.W.
Suite 700
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501